

Appl. No. 10/810,593
Amdt dated March 6, 2006
Reply to Office Action of October 5, 2005

Amendments to the Specification:

Please replace the Title with the following amended Title:

~~Method, System, and Apparatus~~ and System for Separating Concentrating Slurry Solids from
~~Drilling Slurry~~

Please replace paragraph [0042] with the following amended paragraph:

[0042] Polyacrylamide~~Polyacrylimide~~ is a good example of flocculating agent suitable for use with the apparatus of the present invention. Polyacrylamide~~Polyacrylimide~~ may be used to agglomerate particulate solids such as cuttings in a slurry stream in order to: accelerate settling rate of solids (clarify) from solution; increase solids density (thickeners, dissolved air flotation); and facilitate mechanical dewatering of solids (e.g. via centrifuges, belt presses, screw presses). In testing, a wide range of flocculants are successful in operating the system of the present invention, however the chemical balance of flocculating agent in the particular slurry composition becomes important to sufficiently separate solids from fluids by the time they reach the inlet, such that focussing the inflowing pre-treated stream on the tank bottom and outlet has the desired effect of concentrating solids prior to entering the centrifuges. Consequently, automated control systems based on various sensing technologies are an appropriate enhancement to optimize system throughput relative to that achievable by a human operator who is continually macro-adjusting flow rates in response to changes in the slurry arising from differences in the composition of the formation at different drilling sites and depths. Further suiting the system of the present invention to automated use with PLCs, it relies on positive displacement pumps (rather than conventional centrifugal water pumps) to refine control over the ratio of chemical to slurry, when blending chemical with slurry, which also achieves more thorough mixing and complete usage (i.e. less waste) of the chemical.

Please replace paragraph [0056] with the following amended paragraph:

[0056] Referring now to Figures 1 – 5, there is illustrated a preferred embodiment of an apparatus denoted generally as 100 comprising a concentration tank 110 having an inlet 115, sidewalls 116, a conical base 117, an outlet 118, baffles 120, chambers 121, ~~overflow fluid~~ return 140, exit conduit 150, and at least one skimmer or drain 160. On start-up, apparatus 100

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is filled with water (not shown) and centrifuges (not shown) may be operated to create suction at outlet 118. A stream of pre-flocculated slurry 135 enters tank 110 from conduit 130 through inlet 115 directly into central chamber 125 where the slurry drops towards bottom space 127 of tank 110 at a volume per unit time sufficient to fill outlet 118 and then backup along annular passage 126 until tank 110 is substantially filled with slurry displacing the water with which it was filled on start-up. In the course of displacing said water, after slurry fills annular passage 126 it rises in central chamber 125 and all chambers 121 - causing water floating on top of separated solids to exit tank 110 via drain 160. As a result of the presence of baffles 120 the profile 210 of solids level 211 will tend to be higher in central chamber 125 as compared to chambers 121 at increasing radial distances from central chamber 125. Whether controlled automatically using a level detector 161 (e.g. Milltronics Multiranger Plus™ ultrasonic device) or manually by a human operator (not shown) monitoring the level of slurry in tank 110, adjusting the flow rate of said stream of pre-flocculated slurry 135 is one way to ensure that clean water 136 (not solids) flows out via drain 160. Adjusting the centrifuge suction at outlet 118, is an alternate or additional means by which to maintain the solids level 211 in tank 110 below the level of drain 160.

Please replace paragraph [0066] with the following amended paragraph:

[0066] According to a preferred embodiment of the system of the present invention centrifuges (not shown) drawing on conduit 150 creating suction at outlet 118 may be used to re-circulate fluid from tank 110 while the volume of fluid being so circulated in a closed-loop is measured. Using any suitable flow meter (not shown) for each pathway the measured volumes exiting via conduit 150 and returning via overflow-fluid return 140 are recorded, such that the volume of solids removed may be calculated as the difference between the two measures. Assuming that the flow meters selected also measure density, the mass density of the solids removed from tank 110 can be calculated. Monitoring the returning stream in overflow-fluid return 140, if the mass density exceeds 1000 kg/m³ then the returning stream includes unwanted solids, which information may be used by a controlling computer to: shut-down, or raise an alarm to a human operator, or temporarily cease diverting any portion of the returning liquid stream to the rig tanks, or adjust the amount of flocculant being injected into slurry 135, or any combination of the foregoing alternative actions. Known traditional problems that lead to the returning stream in overflow-fluid return 140 becoming "dirty" include: exhaustion of the supply of polymer, and failure of the polymer pump, which can contaminate the system. Advantageously, the present invention avoids such contamination, and the downtime of the system is also significantly reduced over the life of each installation such that a low-power

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system actually processes significantly more slurry. If a dual purpose meter is not available, then the density may be determined by any suitable density measuring technology, including but not limited to those manufactured by the Mt. Fury Company Inc. (e.g. Model 610 Solids Concentration Monitor) or IMC Coppas Quebec Ltd. (e.g. Microwave Density Meter).

Please replace paragraph [0067] with the following amended paragraph:

[0067] Modern centrifuges typically come with a controller panel that contemplates the use of a Programmable Logic Controller ("PLC") and a touch screen to operate it. A PLC is flexible and may be used to operate the system by running software written to control the interaction of the centrifuges with other components of the system. For example, an ultrasonic level measuring device can be tied into the PLC and a variable-speed feed pump that is used to adjust the volume in tank 110 according to preset operating parameters, whether as a fail safe against overflowing tank 110 or to facilitate optimal residence time. Ideally, since pre-flocculation is used in the system, the optimal residence time is near zero as no re-circulation is desired once chemical balance is achieved and steady-state is attained. Basically, no matter how fast slurry moves through conduit 130, exactly the same total amount leaves via outlet 118 and drain 160 – with nothing returning through ~~overflow~~fluid return 140 unless fresh water is needed to offset a lack of raw slurry to process. An automated polymer mixing and feeding sub-system can also be tied into the PLC to speed or slow the polymer feed pump as required. Similarly, flow and density measuring meters can easily be interfaced with the PLC to continuously provide it with the data used to incrementally adjust all flows via the pumps and centrifuges. It has been determined that current positive displacement pump technology is more accurate and better suited to use with a PLC than is the pump technology used with conventional flocculation devices. Rapid reaction times and accurate responses are useful to fine tune the system and maintain it at steady-state. For example, monitoring the interrelation of outflow to inflow also permits appropriate solids accumulation at steady state.